

CULTURE SYSTEMS AND THE MULTIPLIER EFFECT

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IT IS VAIN to hope for the discovery of the first domestic corn cob, the first pottery vessel, the first hieroglyphic, or the first site where some other major breakthrough occurred. Such deviations from the pre-existing pattern almost certainly took place in such a minor accidental way that these traces are not recoverable. More worthwhile would be an investigation of the mutual causal processes that amplify these tiny deviations into major changes in prehistoric culture.

Kent Flannery (1968, 85)

AN EFFORT IS made here, however, to treat changes in the rate of growth as determined by the workings of the fundamental variables in the system, rather than as the consequence of exogenous forces.

Walt W. Rostow (1953, 17)

THE SECRET OF the growth of the city is in the process of deviation-amplifying mutual positive feedback networks rather than in the initial condition or in the initial kick. This process, rather than the initial condition, has generated the complexly structured city. It is in this sense that the deviation-amplifying mutual causal process is called 'morphogenesis'.

Magoroh Maruyama (1963, 166)

Cultures as Systems

Operationally defined, a culture is a constantly recurring assemblage of artefacts. To represent the culture as a system or as part of a system, it is useful to consider not only the preserved artefacts, but the members of the society that produced them, the natural environment they inhabited and the other artefacts (including the non-material ones such as language and projective systems) which they made or used. Obviously we cannot have detailed knowledge of all these for prehistoric societies, but it is proposed that we assume

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they existed. The artefacts available today, which we will take to be of known provenance and approximately known date, are the material remnant of this system.

The components of the system are not only the members of the society but the artefacts which they have made or which they used (including the non-material ones) and all objects in nature with which they come into contact. 'Anything that consists of parts connected together will be called a system' (Beer 1959, 8). What connects the components of this particular (and very large) system are the actions between these three classes of individual: man, artefact, natural object. As Katz and Kahn (1966, 94) have written:

The problem of structure, or the relatedness of parts, can be observed directly in some physical arrangement of things where the larger unit is physically bounded and its sub-parts are also bounded within the larger structures. But how do we deal with social structures where physical boundaries in this sense do not exist? . . . The structure is to be found in an interrelated set of events. It is events rather than things which are structured, so that social structure is a dynamic rather than a static concept.

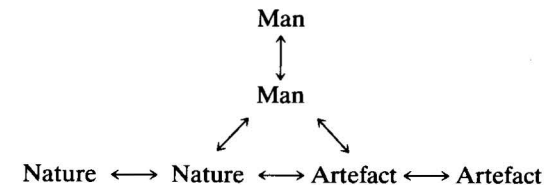


Figure 1. Six kinds of interaction, five of them within the culture system, and one (Nature–Nature) outside it.

The dichotomy here established between man and nature does not support in any sense the view that man is not just an integral part of the natural world, inextricably bound with it. Indeed the whole purpose of utilising the systems approach is to emphasise man–environment interrelations, while at the same time admitting that many fundamental changes in man's environment are produced by man himself. They emerge, that is to say, from technological and social changes rather than simply from ecological ones.

Artefact–artefact interactions can come about without the direct presence of man: when the new wine cracks the old bottle, or when the domesticated cow eats the domesticated wheat. Nature–nature relationships (referring to natural phenomena) are relevant too:

the cow needs grass, the fisherman fish and both the grass and the fish may be beyond the field of man and his artefacts. The overall system which we have to consider, therefore, is larger than man's culture, in that it includes both his environment and man himself.

It is important to realise that the choice of elements which constitute the system is ours. We are free to define the interacting elements which constitute the system. When there are other elements not defined as part of a system, which interact with it, then the system can be said to have input and output: it is an open system.

There are two important points to consider: the boundaries of the system, and the nature of the connections within the system. First, it should be noted, a system can be simplified and portrayed in a new form when its states are compounded suitably:

Were the engineer to treat bridge-building by consideration of every atom, he would find the task impossible by its very size. He therefore ignores the fact that his girders and blocks are really composite, made of atoms, and treats them as his units. . . . It will be seen, therefore, that the method of studying very large systems by studying only carefully selected aspects of them is simply what is always done in practice. (Ashby 1956, 107)

It would be possible, therefore, to consider the atomic and molecular structure of the objects and artefacts, regarding each as a system in itself. Equally the humans participating can each be regarded as a system. For the present purpose, however, these natural objects, artefacts and people are our components.

Just as it is convenient to ignore individual atoms and generalise on a higher level, so it can be convenient to lump together these components, and speak of larger units. When these larger units themselves are structured we may designate them as subsystems.

In order to establish the nature of the boundary of the culture, the man-environment system of the given culture can be described in terms of the individual settlement units as distributed in space. No settlement in the Old World is completely isolated from any other: we can imagine the situation, say 5,000 years ago, when each village had at least some contact with its immediate neighbours, they with their neighbours, and so on, creating a great lattice across the whole of Europe and indeed Asia, and only stopping perhaps at the Pacific and Atlantic Oceans. 'No man is an island unto himself, each is a peninsula, a part of the Main.'

In deciding on the spatial boundaries of our system we are thus making a somewhat arbitrary decision – as we are entitled to do. As

archaeologists we follow the record of the artefacts. The archaeologist considers the distribution of artefact types, and sets the boundaries of the archaeological culture according to convenient criteria. We follow these, and indeed assume that the uniformity within the culture area is due to the contacts and inter-connections described. The greater difference with the outside region is generally assumed to be due to diminished contacts and interrelations.

For different purposes we shall draw the boundaries differently: at one moment for example we may wish to consider the Minoan civilisation, perhaps in the seventeenth century BC, and will draw the boundaries accordingly, at the next we may refer to the Minoan-Mycenaean civilisation (say, of the fourteenth century BC). Criteria of different degrees of uniformity will lead to the definition of larger or smaller units.

We should note too that with the passage of time the elements of the system are changed: people die and are born, artefacts made and discarded. As von Bertalanffy says of organic systems (1950, 155):

It is the basic characteristic of every organic system that it maintains itself in a state of perpetual change of its components. This we find at all levels of biological organisation. In the cell there is a perpetual destruction of its building materials through which it endures as a whole. . . . In the multicellular organism, cells are dying and are replaced by new ones, but it maintains itself as a whole. In the biocoenosis and the species, individuals die and others are born. Thus, every organic system appears stationary if considered from a certain point of view. But what seems to be a persistent entity on a certain level is maintained, in fact, by a perpetual change, building up and breaking down of systems of the next lower order: of chemical compounds in the cell, of cells in the multicellular organism, of individuals in ecological systems.

No one is saying here, of course, that a cultural system can be equated with an organic system: but it does share certain properties with them, and with Heraclitus's river: 'A man never bathes in the same river twice.'

Our culture system is also of great complexity because of the nature of its interconnections. Already in talking, say, of trading connections alone, it can be broken down into subsystems. Each single settlement unit can itself be regarded as a subsidiary trading subsystem, and they articulate together to form the overall trading subsystem. The division into subsidiary subsystems here is a spatial

one, and can be represented in the dimensions of space.

But the elements of our system are not only linked by connections between localities, such as those of trade. The man-artefact-natural-object connections provide food and shelter for men, the man-artefact connections involve the manufacture and use of all manner of things, the man-man connections involve kin relationships, and other social relationships and conventions. This is the consequence of the multi-dimensionality of man's environment.

We can regard the people in society as nodes in a lattice connected in numerous different ways, each way corresponding to one of the various dimensions of the environment.

In defining subsystems in the culture corresponding to each of these types of connections (and to each of these dimensions) we are not dividing the society spatially but simply following different kinds of networks:

It must be noted that in a real system the 'diagram of internal connections' is not unique. The radio set, for instance, has one diagram of connections if considered electrically, and another if considered mechanically. An insulator, in fact, is just such a component as will give firm mechanical connection while giving no electrical connection. Which pattern of connections will be found depends on which set of inputs and outputs is used.

(Ashby 1956, 92)

In the same way we may picture the incredible complexity of a cultural system, acting in several dimensions and with several different kinds of connections between its components which are itself of several different kinds. In the culture system we are free to define the subsystems. As Wolf has written (1967, 449):

We may regard civilisations as social sets, in which the elements are linked together in a large variety of ways and with different degrees of cohesion. Methodologically this means that we do not have to account for all the elements - only for those which we hold to be significant. When considering civilisation the possible choice is almost infinite.

For our purposes the following subsystems may be distinguished:

The subsistence subsystem. The interactions that define this system are actions relating to the distribution of food resources. Man and the food resources and the food units themselves are components of the subsystem which are interrelated by these specifically subsistence-oriented activities.

The technological subsystem. This subsystem is defined by the activities of man which result in the production of material artefacts.

The components are the men, the material resources, and the finished artefacts.

The social subsystem. This is a system of behaviour patterns, where the defining activities are those which take place between men. It is not possible to distinguish clearly all the activities of the subsistence and technological subsystems from those of the social subsystem, but the essential point in the latter is that we are no longer looking at activities under their aspect of food production, or of craft production, but looking at them as patterned inter-personal behaviour. It would be possible here to distinguish an economic subsystem from the social subsystem, but it is probably simpler in a non-market society to look at the accumulation of wealth as a social phenomenon at least as much as it is an economic one.

The projective or symbolic subsystem. Here, we are speaking of all those activities, notably religion, art, language and science, by which man expresses his knowledge, feelings, or beliefs about his relationship with the world. The social systems may involve activities that are expressive of relationships in this way, that are symbolic of relationships between human beings. Making obeisance before the throne of the ruler would be one of these. But we are defining such expression between men as belonging within the sphere of the social subsystem. The projective systems, in other words, are those in which man gives formal expression to his understanding of and reactions to the world. His thoughts and feelings are expressed, that is to say projected, and given symbolic form, whether in language or in worship, in the production of written records or of works of art, including music, dance and other abstract forms amongst those of more explicit meaning.

The trade and communication subsystem. This is defined by all those activities by which information or material goods are transferred between human settlements or over considerable distances. The activities here are all those which involve travel, for any of the components of the system whether men or artefacts.

The boundaries between these systems are extremely difficult to define, since a given human action can exist in several dimensions at once. The construction of a temple, for instance, an action of considerable complexity, lies in the first place, in its conception, in the field of the projective systems. It will also involve economic activities. The builders will have to be fed, which belongs in the field of subsistence, and, of course, they will be organised in a manner governed by the social subsystem. This is inevitable since many human actions have a meaning at several levels, with undertones

and overtones. And, as we shall see it is the complex interconnectedness of the subsystems which gives human culture its unique potential for growth.

These are the subsystems whose functioning must be isolated if we are to reach an understanding of growth and change in the culture. The growth and development of metallurgy is also given special consideration in the next chapter since it was obviously of central importance in the third millennium Aegean, although in more general terms metallurgy is simply one aspect of craft technology. Population is a basic parameter of society rather than one of its subsystems. Population increase in most early civilisations, was one of the most significant and relevant developments.

Feedback

In a culture which is not changing, the various subsystems are in a state of equilibrium (or, in more specialised jargon, of quasi-stationary equilibrium). There is continuous activity: food is grown and eaten, buildings collapse and are repaired, imports and exports are produced and consumed, social relationships are observed, religious services are held. This year, next year, the 'same' things happen: people are born, married, die but nothing is new. This is the working of habit and convention. Hawkes (1954, 155) has emphasised this consistency in the norms of human behaviour:

The human activity which (archaeology) can apprehend conforms to a series of norms, which can be aggregated under the name of culture. . . . The notion of norms in man's activity . . . is an anthropological generalisation based on the extensive degree of conservatism shown by primitive man in his technological traditions. . . . Without this the whole subject would crumble up.

We are all creatures of habit, otherwise we could not face the alarming multiplicity of 'new' problems which would arise. As Samuel Beckett has said, 'L'habitude est une grande sourdine.'

But, of course, the system is not so stable as this: fluctuations in the natural environment alter the equilibrium. Fishing is poor and there are less fish to eat: there are more births than usual and more mouths to feed: it is a wet summer and the roofs leak: an eclipse of the sun is seen as a dread portent. And then there may be 'input' from right outside the system: military attack from another culture, for instance. Or innovations within it: a new tool is invented, or there is dissatisfaction with the conduct of the chief. The remarkable thing is that in every case each subsystem acts homeostatically,

to counteract the disturbance. In the subsistence system the level of food is stabilised either by greater investment in fishing, or by switching to other foods. In the utility subsystem roofs are repaired. In the religious system appropriate steps are taken to counteract the alarming disturbance. Military attack is opposed, the new tool replaces the old, the chief takes measures to enhance his authority. Each of the subsystems of the culture is acting like a stabilised or regulated system, in the cybernetic sense. Their variables (food level in the subsistence system, population in the demographic situation, integrity in the defence system, social behaviour in the social system, belief behaviour in the religious system) are kept within assigned limits, as is necessary for survival (Ashby 1956, 197). The behaviour of the culture (and doubtless the artefacts which the archaeologists will recover from it) is essentially unchanged. Various interesting consequences flow from this, for example the need for variety in the culture to oppose undesirable variety outside it (Ashby 1956, 206f.).

Indeed each subsystem can be so regarded as self-regulating. And the different dimensions of life can be considered independently. But at the same time we must remember that in the culture system the component subsystems do not vary independently, they are coupled. This is, of course, simply a statement of anthropological functionalism, that different aspects of a culture are all interrelated. It does not mean, however, that changes in one subsystem *must* necessarily produce changes in all the others.

The equilibrium in a subsystem of the culture is achieved by automatic regulation which acts, like Le Châtelier's principle: 'If a system is in stable equilibrium and one of the conditions is changed, the equilibrium shifts in such a way as to restore the original conditions.' It operates by means of negative feedback: the ability to meet an effect by operating in such a way as to oppose it and thus minimise change. If the food resources of the society suffer a setback (a poor harvest for instance), the society acts in such a way as to restore the level of food supply, for example by trade, and thus to minimise the disturbance. The system acts to counter the disturbing force, so that the feedback is negative.

All this, then, gives us some understanding of the essential coherence and conservatism of all cultures: the behaviour patterns in one generation are communicated to the next generation: the society's 'adjustment' or 'adaptation' to its natural environment is maintained: difficulties and hardships are overcome. Minor changes may be brought about through ineffectiveness in this communi-

cation: the pottery decoration of a daughter may differ a little from that of her mother. But this is merely a 'random drift' which does not in itself have a significant effect on the life of the society. Only if the outside disturbance is so great that the homeostatic controls cannot overcome it, is the life pattern disrupted. 'When a system's negative feedback discontinues, its steady state vanishes, and at the same time its boundary disappears, and the system terminates' (Miller, quoted Katz and Kahn 1966, 96).

Thus, a military attack will be resisted by the society. But if it cannot be overcome, it may well produce a disturbance beyond the limits of tolerance of the system: the system breaks down. Or natural environmental forces may produce a serious disturbance: the increasing salinity of the soil of Mesopotamia was a disturbance which the inhabitants of the Sumerian heartland strove to overcome (Jacobsen and Adams 1958). A similar theory, involving progressive flooding and silting, has been used to account for the decline of the Indus civilisation (Raikes 1965). And the eruption of the volcanic island of Thera certainly brought a total end to the human system occupying that island just as that of Vesuvius to Pompeii. It has even been suggested that the disturbance produced by this eruption was so strong as to exceed the homeostatic controls of the entire Minoan system in Crete and to bring about its disintegration.

In all this the culture system is acting negatively, passively almost, simply acting to regulate outside events. While the negative feedback picture is effective, then, in illuminating the stability and conservatism of the society, it does not explain how society will ever change, except through an outside challenge. It is limited to the Toynbee concept of cultural response to natural environmental challenge.

The systems approach does offer also a convenient model for growth, for change occurring *within* a society. Negative feedback itself is never a sufficient explanation for cultural development, for how culture came into being, but merely for how an existing order was modified through external change. Change, progressive change, can however be considered in terms of deviation *amplifying* mutual causal systems.

Such systems are ubiquitous: accumulations of capital in industry, the evolution of living organisms, the rise of culture of various types, the inter-personal processes which produce mental illness, international conflicts, and the processes which are loosely termed 'vicious circles' and 'compound interest', in

short of all processes of mutual causal relationship that amplify an insignificant or accidental kick, build up deviation and diverge from an initial condition. (Maruyama 1963, 164)

Kent Flannery (1968, 80) has described such a *positive feedback* system which operated in the system of wild grain procurement in early Mesoamerica and resulted both in the selection for genotypes of the domesticated maize and in the development of food production. As he well says:

The use of a cybernetics model to explain prehistoric cultural change, while terminologically cumbersome, has certain advantages. For one thing it does not attribute cultural evolution to 'discrepancies', 'inventions', 'experiments' or 'genius', but instead enables us to treat prehistoric cultures as systems. It stimulates enquiry into the mechanisms that counteract change or amplify it, which ultimately tells us something about the nature of adaptation. Most importantly, it allows us to view change not as something arising *de novo*, but in terms of quite minor deviations in one overall part of a previously existing system, that once set in motion can expand greatly because of positive feedback.

A culture, as we have seen, may be considered as composed of coupled systems, and the nature of their coupling is very relevant here and has to be considered. Its stability and growth is determined by the behaviour of these systems – in which human beings participate, of course, and human ideas, so that the growth is not 'determined' in a materialist sense. As Maruyama has written (1963, 178):

Sometimes one may wonder how a culture, which is quite different from its neighbouring cultures, has ever developed on a geographical background which does not seem to be in any degree different from the geographical conditions of its neighbours. Most likely such a culture had developed first by a deviation-amplifying mutual causal process, and has later attained its own equilibrium when the deviation-counteracting components have become predominant, and is currently maintaining its uniqueness in spite of the similarity of its geographical conditions to those of its neighbours.

This, then, is the growth process which we are seeking to analyse and which can be discussed with the minimum of jargon, although terms such as positive feedback and negative feedback are necessary. Next an attempt is made to look more carefully at the precise conditions which may give rise to growth, and not only to growth in

size but to fundamental changes in the structure of culture, leading ultimately to the emergence of civilisation.

Growth and 'Take-off' in an Economic Subsystem

An informative and stimulating approach to economic growth focuses on the problem of the interaction of different factors (Rostow 1953). The analysis is in terms of factors primarily *within* the system. Rostow's own interest again lies in the problems of developing countries, and the circumstances favourable to their economic 'take-off'. Our own lies in the possible analogy which this suggests for the 'take-off' leading to the formation of early civilisations, and on the insight it may give into the way interactions operate between the component subsystems of the culture.

The analogy is not, of course, a complete one, since none of the early civilisations which we have in mind move beyond Rostow's traditional stage. Yet there are interesting and suggestive parallels between the process of growth from traditional to industrial civilisation, and that from subsistence economy to early civilisation, the transformation which we are seeking to explain.

Rostow's approach is basically one of common sense: its originality lies in a willingness to consider a multiplicity of long-term factors, and above all in the attempt 'to treat changes in the rate of growth as determined by the workings of the fundamental variables in the system rather than as the consequence of exogenous forces'. It is this which makes his work relevant to the present problem.

His analysis of the forces governing changes involves three basic statements about the workings of society:

1. The economic output is determined by the size of the working force, the society's stock of capital, and its stock of knowledge. The rate of growth is therefore a function of the rate of change of these factors.

2. The first of these factors is itself governed by five 'economic subvariables': these comprise the rates of birth and death (prior and current), the role of women and children in the working force, and the skill and degree of effort of the working force.

The second factor, the size and productivity of capital, is seen as governed by six subvariables, namely the volume of research in pure and applied science, the proportion accepted of the flow of innovations, the balance between consumption and current investment, and the yield from additions to capital stock.

3. These economic subvariables are themselves seen as dependent upon six further variables or propensities, 'the human deter-

minants of economic action': the propensity:

- to develop fundamental science
- to apply science to economic ends
- to accept innovations
- to seek material advance
- to consume
- to have children.

These 'propensities' are in turn seen as 'a function of the prior long-period operation of economic, social and political forces which determine the current social fabric, institutions and effective political theory of the institution'. Clearly these propositions do not offer an explicit quantitative analysis of the growth which they set out to explain. But they 'are designed to constitute a link between the domain of the conventional economist on the one hand, and the sociologist, anthropologist, psychologist and historian on the other. . . . They also aim to provide a focus for the efforts of non-economic analysis interested in economic phenomena . . .'

Rostow's book goes on to analyse the problems of modern developing societies in these terms. The interest of these ideas here is the explicit realisation 'that actions which result in economic advance need not to be motivated by economic goals'. The analysis of an economic subsystem is dependent on 'propensities' – such as the acceptance of innovation, or consumption, which are only in part economic and are not necessarily governed by economic factors. Indeed of these six propensities only the last two fall directly within the scope of Malinowski's 'primary needs' (Malinowski 1960, 91).

These are variables which, while endogenous to the society in question, may be regarded as exogenous to the economic subsystem. Once again the interrelations between subsystems are seen as crucial. 'Economic action is . . . the outcome of a complex process of balancing material advance against other human objectives . . .'

The developments in the formative period which led to the establishing of one early state society, will be considered below. They may profitably be regarded in this way, taking economic changes not in isolation but within the context of their impact on the society as a whole. For it is this impact, most clearly evident in social terms, which determines the long-term features of the economic progress in question. It is clear that the period in question was one of change. Many innovations were widely accepted at this time and subsequently, when an international spirit, a cosmopolitan feeling, can be detected. The obvious superiority of the metal tools and weapons, for instance, over their stone counterparts may have led

to their rapid acceptance. This in turn led to the adoption of other new methods and ideas. This was a time of change, change induced indeed partly by the sudden significance of metal. And in such times of change, as Boserup (1965) hinted, other innovations seem to have found ready acceptance. The propensity to accept innovations does indeed seem a significant factor in considering these developments.

The metallurgical and other technological developments do indeed show a notable dynamism in the development and application of new techniques and processes. The bearing of Rostow's first two propensities is obvious, although in early state societies there was hardly a valid distinction between pure and applied science.

Above all, the propensity to seek material advance, and to consume, are factors which are relevant to the origins of most early state societies. They are often overlooked in analyses of culture change, or even dismissed as 'superficial reductionist'. (It must none the less be admitted that the simple naming of 'propensities' is in itself far from an explanation of growth, but merely a first step in that sense.) For instance, the development of metallurgy created new forms of wealth, and indeed new forms of consumption. The propensity to consume was given new scope by its introduction.

Probably, however, in most prehistoric societies the propensity to seek material advance was still limited to a large extent by social factors. A prince, or 'head of state' for instance, might well deliberately accumulate wealth in order to dazzle and influence both his subordinates and his peers by its display. But we may question whether there was any very high degree of social mobility at this time, and whether social advance could effectively be secured by increased work or production.

The analysis does, however, suggest an emphasis on one feature common to all civilisations: a willingness to invest income and hence to accumulate what may be regarded as capital. Both goods and labour were lavishly employed in the construction of significant religious or social centres, often of palaces. At first sight much of this investment was unproductive, contributing solely to the magnificent appointments of the palace or to the rich burial goods which accompanied the prince and his family to the grave. but this is to overlook the socially cohesive effects of such investment. And the production of these increasingly magnificent objects (the increase itself a sign of willingness to accept innovation) was the only possible way of conducting 'research' in the fields of pure or applied

science. In prehistoric times most knowledge was practical knowledge – and this does not, of course, exclude religious experience, since religion is itself to be regarded in functional terms as a special technology. Innovations must have arisen most frequently not from deliberate research and its application, but from the 'spin off' consequent upon the developing production processes employed in the palace or temple workshops and beyond.

The palace, or the temple, as the focus of highest population density and the location of the majority of specialist processes (at least in many early state societies), from metallurgy to accounting, constituted – together with its implicit social system – the main capital stock of the community. And 'whether a rate of growth can be sustained depends on whether investment . . . is sustained' (Rostow 1953, 95). The developing social system ensured that both investment and the rate of growth were indeed sustained.

This emphasis upon the propensities to consume and to seek material advance is of course not a new idea, and many economists stress that sustained growth over a considerable period requires modifications of economic and perhaps social organisation. As J. K. Mehta has written (1964, 95), continued growth of real income depends

on the extended use of the ability to plan and organise human efforts. It is organisation whose elasticity can ensure a sustained rate of growth of national income.

If there is any factor that possesses elasticity in a degree that we need for growth, it is organisation. This factor, which is perhaps capable of stretching itself to any required limit, is behind growth. But circumstances must be favourable to enable it to stretch itself. These circumstances are related in the final analyses to the behaviour of producers (determined partly by their habits and partly by their psychological reaction to consumers' behaviour) and the behaviour of consumers.

For the study of growth it is necessary, therefore, to make some plausible assumptions about the behaviour of buyers of productive services (producers) and those of consumption-goods (consumers).

Of course the language of economics, formulated where a money currency establishes a precise and stable equivalence between different kinds of goods and services, cannot be applied to societies without a formal exchange system. It is absurd to read into early societies the economic concepts of modern marketing and currency. Such statements as these cannot be directly applied, but at the level

of analogy they are certainly indicative of relevant factors.

At a certain point, indeed, the analogy between economic growth and the growth of a culture or civilisation breaks down. In the first place an important criterion which the economist takes to indicate the transition from a preponderantly agricultural basis to an industrial one is the rate of increase in *per capita* output. In an essentially non-industrial society, even at the peak of its development, the rate of increase, however measured, cannot have been very great. Moreover, such an economic analysis, while refreshingly considering the effect of non-material factors on economic growth, is still restricted in its scope to the growth of the economy, not to the development of the culture as a whole. The analysis does not, therefore, offer full scope for a consideration of the interactions of all the factors relevant to this larger problem, although it works in the same sense. But it is precisely this question, as to how changes in one field of human activity – in one subsystem of society – produce changes in another, which requires further consideration.

The Multiplier Effect, and the Interaction Between Subsystems

One of the distinguishing features of human societies is the extent to which changes within one subsystem of society bear upon other subsystems. Population does not simply grow, for instance, and then reach a stable level, governed purely by environmental factors, as it might in the case of most animal populations. Instead a dynamic interaction is set up between the population level and the means of food production. There is innovation, and the acceptance of innovation. A new adaptation is seen: a new farming mode, which amounts to a new structure of food-production procedures, a new configuration among human activities. In the terms discussed above, there is very considerable elasticity in organisation.

The growth which we are here considering consists in the establishment (and survival) of new relationships, new patterns of activity. This often implies the desuetude of many of the old relationships and activities, so that the changes which result are often irreversible. The analogy in the organic world of nature is here not with the growth of a single member of a species (the ontogeny), since this implies no real innovations in patterns and relationships already established, and is largely a question of size, of scale. It lies rather with the evolution of a new species (the phylogeny) where real innovatory changes, the result in this case of mutation, lead to new adaptations and the irreversible movement away from old ones.

Systems theory has indeed made clear to us the way in which 'regulators' can achieve a dynamic balance in a system. And most branches of human activity are governed in the same way. Human conduct is regulated by all the rules, pressures and incentives of society: there are ways things are usually done, and things which are not done. Indeed it is generally normal in a human culture for things to go on much as they have before.

Here, however, the problem is a different one. The regulatory efficacy of culture is accepted. The question is now the opposite one – how and why does it change or grow?

Growth in numbers or in size is itself inhibited by the regulatory mechanisms. When the birth rate rises very rapidly, for instance, the death rate may also rise, and population growth is limited. These restricting mechanisms can only be overcome by deviation-amplifying mechanisms which actually favour growth of certain kinds. This is the positive feedback also discussed above. In favourable circumstances 'one thing leads to another'. A change, for instance an increase in capital investment, leads to an increase in production. And this outcome works now to amplify the initial change by allowing a further increase in investment. In this way a 'growth cycle' develops, subject to what the economist calls the Law of Diminishing Returns. After a period of sustained change or growth, further change (e.g. further investment increase) no longer has so large an effect as before (e.g. on output). A kind of saturation is reached, and the growth ends. The feedback, in other words, is no longer positive.

Once again there are analogies in chemistry: we have already seen above that when a chemical reaction is reversible, a negative-feedback regulator operates, designated Le Châtelier's Principle. but when the reaction is irreversible this does not hold. In some reactions, which are self-catalysing, the faster a reaction is taking place the faster its rate increases: this is a positive feedback situation. But later, often as the available resources are used up, the reaction rate falls again: by analogy we may say that the law of diminishing returns is operating.

The growth of human societies is not always subject to this law of diminishing returns precisely because the underlying structure is itself changed in the growth process, just as in the economic situation summarised by Mehta above. Innovations arrest or negate the operation of the usual limiting factors. This change of structure is something the cyberneticist can hardly handle yet – the structures of the systems with which he deals do not generally transform them-

selves into something different.

The key to this process in human cultural development lies in precisely the interconnectedness, identified in the preceding section, among the different activities of the individual in society, the interdependence of the subsystems of society. There is, indeed, a new kind of positive feedback among innovations – an innovation in one subsystem tends to favour innovations (and their acceptance) in another, in a manner quite foreign to the other species of the animal world. (Although there may be a superficial analogy with the working of ‘explosive evolution’ in organic evolutionary development.)

I propose to term this mutual interaction in different fields of activity, this property of human systems that an innovation (and its acceptance) in one subsystem favours innovation in another, this interdependence among subsystems which alone can sustain prolonged growth, the *multiplier effect*.

This term does not simply imply positive feedback, as in the ‘accelerator’ and ‘multiplier’ of the economists. It indicates the process whereby changes in one field of human activity can significantly influence changes of quite a different kind in another field. The following definition of the multiplier effect seeks to emphasise this distinction from the usual working of positive feedback within a single subsystem:

Changes or innovations occurring in one field of human activity (in one subsystem of a culture) sometimes act so as to favour changes in other fields (in other subsystems). The multiplier effect is said to operate when these induced changes in one or more subsystems themselves act so as to enhance the original changes in the first subsystem.

This, then, is a special kind of positive feedback, reaching across between the different fields of human activity. The term multiplier used in this sense implies rather more (although with less precision) than the technical term ‘multiplier’ in economic theory, as formulated by Kahn and used by Keynes with reference to employment and income (Keynes 1937, 115–16). Already it has been extended beyond this original use by geographers who speak of regional multipliers (cf. Chisholm 1966, 99) to elucidate the way in which industrial expansion, within a specified area, has secondary effects there, arising from the presence of the new population and the need for service industries:

This analysis stresses the interrelations of sectors *within* a regional economy and the spread of impulses originating in any

one sector to all other sectors either directly or indirectly. Such spreading in essence has a multiplying result. Through the continuous back and forth play of forces (or round-by-round process of interaction), such spreading leads to a series of effects on each sector, including the original one, although these effects need not always be in the same direction, and of significant magnitude. The relevance of multiplier studies for programming regional development is obvious. It neatly points up how growth in one sector induces growth in another. The relevance of such studies for understanding regional cycles is also obvious as soon as we recognise, that some impulses may be positive, others negative; some expansionary, others deflationary. (Isard 1960, 189)

Here, however, we are concerned not solely with different sectors in the economy of a cultural region, but in the different sectors in the culture as a whole, without restricting the discussion to purely material or economic considerations. We are extending the meaning of the term beyond its conventional one as an aid to analysis of feedback effects within the economic system. In discussing the growth and development of culture the independent growth within the component subsystems is naturally itself of interest. But we are now using the term to designate the effect of their mutual interconnectedness, which favours positive feedback between the different components of the culture system as a whole.

Identification of the multiplier effect in the culture system is illuminating not solely because it allows us to visualise, and in this sense understand, the growth of a system in terms of factors endogenous to it. Above all it focuses our attention on their interrelationship. It is a commonplace of ‘functional’ anthropology that all aspects of a human culture are ultimately interrelated, and that changes in one aspect should affect other aspects of the culture. The definition of the multiplier effect in the field of human culture is an invitation to investigate the mechanisms of this interconnectedness.

The Multiplier Effect and the Emergence of Civilisation

When the multiplier effect comes into operation, and remains in operation, there is sustained and rapid growth, not merely in the scale of the systems of the culture but in their structure. Changes in one area of human experience lead to developments in another. In this way the created environment is enlarged in many dimensions, and itself becomes more complex. This is, as we have seen, something more complicated than the operation of a simple positive

feedback, causing growth and amplifying the processes already present: it is a feedback system with coupled subsystems, favouring innovation.

The conditions for the multiplier effect to come into operation in such a way as to result in sustained growth in the different sectors of the culture require close consideration. Some writers have spoken of a threshold or take-off point beyond which striking developments occur. To investigate this threshold is essentially to seek the circumstances which bring the multiplier effect into active operation.

When the emergence of civilisation is considered, it seems that the crucial requirement is that there should exist the possibility for sustained growth (and for positive feedback) in *at least two* of the subsystems of the culture. Clearly, if none of the subsystems were free, through the favourable influence of changes in the society, to grow and develop (e.g. agricultural production to increase through the adoption of more intensive farming procedures), the culture has no potential for growth. And if only one subsystem develops in this way, and the multiplier effect does not operate, the nature of the culture as a whole will not fundamentally be changed.

The 'temple' culture of Malta seems an obvious case where a single subsystem, involving religious activities and the construction of the great temples, clearly underwent dramatic expansive developments. But for whatever reason this does not seem to have produced detectable positive developments in other subsystems (whether technological or economic). Why this should have been so remains to be investigated – perhaps limited agricultural potential, and the lack of raw metals were significant negative factors – but the outcome was not a civilisation, merely a neolithic culture boasting remarkably sophisticated temples.

It seems that no single factor, however striking its growth, can of itself produce changes in the structure of the culture. For a 'take-off' at least two systems must be changing and mutually influencing their changes.

The Sumerian civilisation has at times been attributed primarily to the invention of irrigation, a single factor which supposedly yielded a food surplus, and made possible the Mesopotamian class structure, with its priests and princes, and the growth of the city. This notion of a food 'surplus' as the 'cause' of further growth has been effectively demolished by Harry Pearson (1957, 320) and George Dalton (1960; 1963). It is inevitable, of course, that any society which has non-food-producing specialists of any kind must have a subsistence situation whereby one food-producer can pro-

duce more than he eats. But the term 'surplus' in a non-market, non-money economy is without meaning, indeed a contradiction (Dalton 1960, 485): if it refers to an experienced growth of output, it would be better to say so. As Dalton (1963, 389) has forcefully asserted: 'To attribute the existence of non-food producers to a food surplus – in the sense that a growth in food supply actively caused the priests and rulers to arise – is, to put it bluntly, silly.' When French farmers dump their artichokes in the road during a glut, there may well be a surplus, but in what sense is the Sumerian peasant's contribution to the temple 'surplus', or the goods destroyed in a potlatch? To regard all subsistence products not actually eaten by the producer and his family as 'surplus', and to ignore the real significance of activities even so apparently wasteful as a potlatch, is to make so total a distinction between the subsistence economy of the neolithic and the craft economy of early civilisations that the gap cannot be bridged. As Pearson (1957, 339) has said, referring to the many societies where 'potential surpluses' are available (i.e. where an increase in food production would be possible): 'What counts is the institutional means for bringing them to life. And these means for calling forth the special effort, setting aside the extra amount, devising the surplus, are as wide and varied as the organisation of the economic process itself.' Dalton (1963, 392) points out: 'In *some* circumstances a growth in food supply may be a necessary condition for social change to come about: *it is never a sufficient condition.*' This is very relevant to all early civilisations. Indeed he goes on to state: 'In other circumstances, as we are now learning from economic development in primitive areas, just the opposite may be the case: social change may be a necessary condition for allowing an increase in the food supply to take place.'

Since civilisation, with its artificial environment, does imply some specialisation, every civilisation must have an economy which has progressed in some sense *beyond a subsistence economy*. But this does not mean that the growth of civilisation was 'caused' by improved food-production techniques, which may indeed in some cases have long been available. In many cases, I suggest, it did in fact come about through innovations in such techniques *coupled with* social and other developments which at the same time made these subsistence improvements both possible and desirable.

Robert Adams, on the other hand (1966, 12), draws 'the conclusion that the transformation at the core of the Urban Revolution lay in the realm of social organisation.' This view now seems to tend rather towards the other extreme, and recognise as 'cause' what was

previously identified as 'effect', and vice versa. One is reminded here of the rather similar divergence in the views of Malthus and Boserup, where the former regarded the food supply as the 'independent variable', and the latter the population density. For indeed, as Adams himself has stressed, the social organisation could not have emerged without the possibility of increased *per capita* food production among the agricultural producers. The two developments are coupled and cannot with profit separately be labelled 'cause' and 'effect'.

The implication of this view, which can indeed be formulated as a testable prediction, is that we shall not expect the archaeological record for the early development of a civilisation to show greatly improved production techniques (e.g. irrigation) and 'surplus' storage facilities arising prior to, or without evidence of social stratification (e.g. palaces) or religious specialisation (e.g. temples). Nor shall we, in the cases where the successful transition to civilisation was later accomplished, expect these social and religious advances to have developed markedly without developments also in food production. On the contrary, the two were linked by the multiplier effect, and it was their coupled expansion which led to rapid changes in the culture in general.

In the same sense, the development and increase of trade, for example in the early Aegean, cannot alone be regarded as the principal factor leading to the development there of civilisation. Without its strong interactions with other sectors of the culture, such as social organisation, the multiplier effect could not effectively have operated.

We may even suggest that social stratification itself is not automatically a necessary contributing element in the growth of civilisation, although the emergence of certain new social structures would indeed seem inevitable. The documented remains of the Indus civilisation, for example, are notably lacking in evidence for great personal wealth, and so far, although public and communal buildings are known, there are no great temples or rich palaces. We can imagine (perhaps a shade frivolously) a socialist state, with communes and with specialists, yet without social stratification in the sense of a hierarchical, rank-order structure in the society. Such a state would have a developed social organisation, of course, but not a pronounced social stratification.

It is, of course, at the level of the individual in society that the multiplier effect actually operates. And it is through the individual that social pressures, for instance, have an economic significance,

for the various subsystems of the culture are linked at the level of the individual. It is therefore by a consideration in terms of individuals, on a micro-economic scale, that the precise mode of operation of the multiplier effect must be elucidated.

On a micro-economic scale, then, the farmer in an ideally simplified neolithic society produces enough for the needs of himself and his family. There is little point in producing much more food than they can eat, since there would be nothing for him to do with it. (He thus avoids a surplus, except in occasional years of unexpectedly high crop yields.) His needs are satisfied. His environment is stable.

Various innovations may work to change this situation. The social subsystem may require of him some conspicuous act of generosity or prosperity (such as a potlatch contribution) to maintain or enhance his prestige. Here then is a crucial new concept (although one implied in Rostow's schema) – a derived secondary need in Malinowski's sense.

I find it impossible to envisage an explanation for change and growth in society without some reference to the 'new needs' which the operation of such factors produces, the material demands and obligations arising from social and religious considerations. Man shows great mobility or elasticity in his requirements: workers today will withdraw their labour on the grounds of unsatisfactory conditions, which would have been accepted as generous a century ago. A telephone, a car, a television set are legitimate needs in the city today, while a generation or two ago they belonged to the realm of fantasy. No explanation for culture change which fails to acknowledge the appearance of such new needs can be effective.

Of course there is evidence for competition and display among other animal species (Wynne-Edwards 1962), and it is not their existence, but the way the society is adapted to facilitate them, which is a unique feature of human culture. And the line of argument can become a circular one if we 'explain' a new feature 'because' we believe there to have been a 'need' for it. A more thorough investigation of the nature and working of these 'needs' and 'propensities' is demanded.

Without acknowledging competition as a significant factor there is no way of explaining, for example, the introduction of weapons. And, above all, without acknowledging a desire for prestige, and the principle that prestige frequently relates to wealth, it is difficult to explain social stratification. These propositions do not, however, amount to natural or universal laws for human behaviour – in a monastic order of poverty, for instance, the monk who cannot bring

himself to discard earthly riches may be little esteemed.

Most of man's activities exist in many dimensions, as the discussion above sought to show. To draw a further analogy with economics, man's 'currencies' within the different dimensions are to some extent interchangeable. Prestige can be related to economic gain, while religious fulfilment may adequately be substituted for the latter. The notion that 'every man has his price' implies that material goods can be set against a 'currency' in the social dimension, such as honour. Moreover in each dimension man shows considerable income elasticity of demand: 'the more you have, the more you want'. In non-monetary and non-market societies these are not scalar quantities – a man may set life above love, love above honour, and honour above life – and no universal equation is possible. As Rostow implies, it is this interaction between the various dimensions of human existence which, together with man's income elasticity of demand in various fields, makes culture growth possible.

A palace, such as is found in many early civilisations, has functions which far exceed the primary one of providing bodily comfort for a segment of the community. And a temple, whatever its history, is referable also to a quality or propensity in human beings not discernible in other animals. No explanation of civilisation can proceed without recognising this basic difference in potential among species, although we cannot expect to explain these fundamental circumstances – that is the province of psychology, of physiology, of cybernetics perhaps, and of biochemistry. Our explanation must start by assuming that all societies of men share these potentialities, for at present there is no convincing evidence that they do not. Obviously an explanation in terms of group or racial 'superiority' or 'creativity' is to be rejected at once, unless there are striking and conclusive new observations in anthropological science to warrant such a theory. The explanation which we are seeking operates, rather, within the field of man–environment interactions, to trace how innovations and their acceptance produced irreversible changes in certain cultures, leading in some cases to civilisation.

The story of the development of these innate human potentialities during the process whereby *Homo sapiens* emerged from his predecessors belongs largely to the field of physical anthropology. But most anthropologists believe that man as born today does not differ significantly from man as born 10,000 years ago. In analysing the genesis of a civilisation we are operating, therefore, in the domain of cultural development and evolution, not of strictly bio-

logical evolution.

As this chapter has tried to outline, we have a possible formula for the explanation of culture change. It is accepted that societies and cultures live in a state of equilibrium: the subsystems which operate in the society are regulated so as to minimise the disturbances to the human environment caused by fluctuations in the natural environment, by outside human agencies or by innovations within the society. For any significant change to take place the innovations must be linked in a deviation-amplifying mutual causal system: the innovation produces effects which favour the further development of the innovation. In some cases the innovation arising in one subsystem has marked effects in other subsystems: this is a feature specifically of human societies with their goal mobility, where needs or aims in one dimension are sublimated to other dimensions. In such a case, if positive feedback occurs, the multiplier effect can come into operation: coupled developments occur in both subsystems, and the innovation is favoured. When the structure of the subsystems is such that marked change can occur in them (for instance when a technological threshold such as the invention of metal casting, or the sowing of grain, can be surmounted) a cultural 'take-off' is possible. Most or all of the subsystems of the society will then undergo marked structural change.

The operation of the multiplier effect – of positive feedback situations within *and between* coupled subsystems – produces a 'revolution' in the sense intended by Gordon Childe (1950). This applies equally to the Neolithic, Urban and Industrial Revolutions. Each may take a long time to mature, since these are not sudden quantum shifts, but continuous processes of change. But in each case the rate of innovation and the speed of structural change in the society are much faster over a considerable period, which we regard as the duration of the revolution itself.

Of course these 'subsystems' and the 'positive feedback' between them are theoretical constructs, terms which we have ourselves created in order to talk about such changes. But if they lead us to formulate new hypotheses which can be tested in the archaeological record – to posit, for instance, a correlation between one observable factor and another in a given culture – then they are fruitful constructs. A model such as this offers many features as yet unexplored by archaeologists and anthropologists: it might even be capable of sustaining exact and quantitative formulations, were sufficiently comprehensive archaeological data available. [1972]